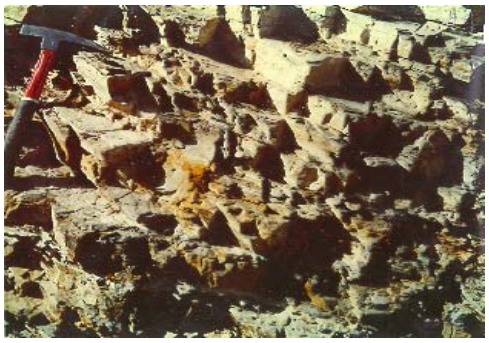
Sandia National Laboratories

Geomechanics Department

Focus

The Geomechanics Department addresses cross-cutting issues in the geosciences and geoengineering related to rock mass characterization, rock mass mechanics, development of numerical codes and numerical simulations, validation of material models and design procedures, and rock mass site monitoring. Supported by combinations of laboratory work and *in situ* observations, the Geomechanics Department emphasizes:

- Characterization of natural fracture systems
- Identification /modeling of rock deformation and failure processes
- Laboratory determinations of thermomechanical and transport properties of competent rock and natural fractures, including studies of coupled effects
- Extrapolation of laboratory measurements to field conditions
- *In situ* stress measurements and evaluation of *in situ* boundary conditions
- Laboratory and bench-scale validation studies



Joint rock mass

Laboratory Facilities

Load frame and pressure vessel

- 0.1-5 MN servocontrolled testing machines
- 1 MN/10kN-M normal load/torsion testing machine
- 70 MPa – 1 GPa pressure vessels(15cm maximum cavity diameter)
- True triaxial testing capability
- Hopkinson/Kolsky bar for intermediate rate testing (2.5 cm sample diameter)
- Triaxial creep apparatus ($10^{-10}s^{-1}$ strain-rate resolution)
- Elevated temperature testing to 400°C.
- Permeability apparatus with hydrostatic and deviatoric loading capabilities
- Non-destructive testing facilities including real-time acoustic emissions location system
- Laser surface profiler (10nm resolution)
- Petrographic laboratory
- Specialty machining and sample preparation facilities

Selected Projects

Shear Strain Localization and Evolution of Fracture Systems in Rock: Study of shear localization and factors favoring localization (inhomogeneities, anisotropy, and yield-surface corners) under axisymmetric and true three-dimensional stress states (sponsor: DOE and National Petroleum Technology Office)

Consolidation of Simulated Wasted and Crushed Rock Salt: Experimental studies and modeling of compaction, consolidation, and strength of simulated TRU waste components, buffer materials, and crushed rock salt backfill (sponsor: Waste Isolation Pilot Plant Project)

NNSA National Nuclear Security Administration

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000

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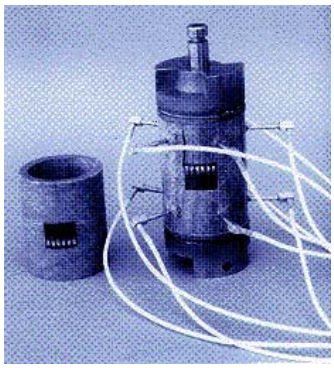
High Temperature Laboratory Creep Data for Special Concretes: Experimental studies and modeling of creep and relaxation in concrete temperatures up to 200°C for applications to repository design (sponsor: Yucca Mountain Project)

Constitutive Behavior of Frozen Soils: Experimental program to determine the properties of frozen soils using a novel triaxial cell capable of triaxial compression at 500 MPa confining pressure and 60°C. (sponsor: DOE Defense Programs)

In Situ Rock Mass Characterization: Use of active and passive ultrasonic transducer arrays to study the development of disturbed zone around openings in salt (sponsor: Waste Isolation Pilot Plant Project)



Thin-walled rock cylinder before torsion test under pressure

In Situ Geomechanics Testing: Design and implementation of large-scale *in-situ* thermal/mechanical tests to study the thermal, hydrological, and mechanical behavior of rock mass under thermal loading (sponsor: Yucca Mountain Project)

Geotechnical Characterization of Underground Storage Facilities: A suite of joint Sandia/ Industry projects to evaluate the feasibility of large scale storage of compressed gas and liquid petroleum in selected geologic formations

Material Behavior Under Impulsive Loading: Study of rock response under dynamic loading, especially near the transition from stress-corrosion dominated crack propagation to kinetic-effects, dominated cracking, for application in drilling, blasting, and penetration problems (sponsor: DOE Defense Programs)

Characterization of Brittle Materials: Study of the response of brittle materials including plastics, epoxies, and ceramics for electronics and other applications to determine their constitutive behavior and fracture characteristics under multi-axial loading (sponsor: DOE Defense Programs)

Mechanics of Powder Compaction for Ceramic Production: Laboratory determination of the mechanical behavior of ceramic powders and development of models to simulate pressing of ceramic components (sponsor: American Association of Ceramic Components Manufacturers)

Dynamic Response of Buried Structures: Employing new arbitrary Lagrangian-Eulerian analysis method that allows the complete coupling of explosive detonation simulation to a structural response code to analyze the response of underground structure to blast vibration (sponsor: DOE Defense Programs)

Geomechanics of Reservoir Management: Sandia/Industry program concerning the effect of *in situ* stress and production–induced stress changes on mechanical and fluid-flow properties of reservoir rocks and natural fractures (sponsor: DOE and National Petroleum Technology Office)

Simulation of Reservoir Response: Development and application of numerical modeling techniques to simulate coupled mechanical-fluid transport effects in oil and gas reservoirs with the aim of providing tools for better management of the recovery process (sponsors: NPTO and Natural Gas and Oil Technology Partnership)

Development of a Coupled Fluid Flow-Particle Motion Code: This code employs the Discrete Element Method coupled with the fluid flow using the lattice-Boltzmann method to simulate the mechanical response of porous media to fluid flow

Development of Disposable Fiber Optic Telemetry System: A prototype fiber optic based system for high speed data communication down hole while drilling has been developed and is being field tested (sponsor: Gas Research Institute)

Installation of Single Heater Test at Yucca Mountain

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